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Variations in rainfall during the summer-half-year (April-September incl) in the coastal area of Central Ayrshire

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The large variations in annual rainfall and their significance is widely recognised. Variations in seasonal rainfall and in their year-to-year behaviour are equally important. This note presents and discusses some data for the summer half-year (i.e. April-Sept incl) rainfall for Prestwick.

The "summer" rainfall is of particular relevance to consideration of "irrigation need" - a requirement which in south-west Scotland appears to be intermittent.

Table I sets out the seasonal totals for the period 1940-69 inclusive, together with the percentage of the corresponding average (base 1916-50). Totals range from 12.13 in (73% of average) to 21.98 in. (131% of average).

The frequency distribution (Table II) is almost rectangular in form (a feature even more emphasised if smaller class intervals are used). Accordingly, the significance of the standard deviation as a statistical parameter is somewhat limited.

Ref. to Table I shows a large year-to-year variation and widely disparate values occurring with a span of about two to four years (see Fig. 1).

The sequential character of the series can be investigated by comparing results for a number of different parameters, eg.

(i) the inter-sequential variability (S.V.) (based on the sequence as given.) (Conrad)

(ii) A modified form $(S.V.)^1$ arising when the totals are arranged in ascending order. (Conrad)

(iii) the number of turning points (p) (a measure associated with (i) (Yule and Kendall 14th Ed) and designed to establish whether the variation is entirely random.

The values for the parameters are respectively

(i) SV = $\pm$ 3.49 inches

(ii) SV^1 = $\pm$ 0.34 inches

(iii) p = 21

Conclusions

From the above analysis we may draw a number of tentative conclusions:

(a) Test (ii), taken in conjunction with the data in Table II indicates that seasonal rainfall (ignoring the sequence of occurrence) varies smoothly and steadily within the range, suggesting that any stated amount within the range can be prudently expected.

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(b) However Test (i) shows that the variability between successive years can be considerable, high and low values following each other within a limited span of years.

(c) Conclusion (b) suggests that the order of successive seasonal totals may be random, and this possibility is further investigated by Test (iii). In a random arrangement of n (= 30) observations, the expected number of "Turning points" is 19 and the standard error of estimate ± 5; the actual number (20) lies well within the permissible limits. The expected phase length in a random arrangement is 1.5 intervals and that between successive peaks (or troughs), 3. intervals: the actual values agree closely with these estimates.

(d) These facts obviously bear upon the interpretation of results from trials carried out over a limited number of seasons. For example, some unpublished work (relating to E Scotland) suggests that intensively managed pastures in areas having an average annual rainfall of 30 inches or less, would benefit from irrigation. In coastal Ayrshire the summer rainfall contributes on average about 45 per cent of the annual total: thus a 'summer' fall of about 15 inches might be judged critical in the context of irrigation. Hence field results obtained in years such as 1951, 1959 must be judged atypical and caution should be exercised in generalising from such results.

References

Conrad V A (1946) "Methods in Climatology" Harvard Univ Press Camb Mass p 228

Yule G U
Kendall M G (1950) "An Introduction to the Theory of Statistics" Griffin London 14th Ed. p701

Table I

Seasonal Rainfall at Prestwick

(a) April–September ("summer half-year") in inches

(b) Percentage of corresponding average (1916–50)

Year	(a)	(b)	Year	(a)	(b)	Year	(a)	(b)
1940	15.48	93	1950	21.11	126	1960	14.56	87
1941	14.41	86	1951	12.78	76	1961	19.41	116
1942	15.37	92	1952	15.68	94	1962	20.52	123
1943	17.28	103	1953	13.55	81	1963	15.27	91
1944	19.72	118	1954	19.67	118	1964	19.53	117
1945	16.99	101	1955	14.15	85	1965	20.84	125
1946	13.92	83	1956	18.55	111	1966	18.68	112
1947	19.13	114	1957	17.85	107	1967	16.14	96
1948	21.98	131	1958	17.94	107	1968	17.01	102
1949	13.41	80	1959	12.13	73	1969	12.97	77

Table II

Frequency Distribution of "summer half-year" rainfall

inches

12.00–13.99	14.00–15.99	16.00–17.99	18.00–19.99	20.00–21.99
6	7	6	7	4

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Fig. 1. Seasonal (Summer half-year rainfall totals) at Prestwick.